



“Frame-Dragging, Cryogenics, and Space: The Gravity Probe B Experiment”

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Abstract

Space research makes intense demands, but opens new ways to physics experiments impossible on Earth. Launched in 2004, the NASA/Stanford Gravity Probe B experiment displays both along with the fascinating intersection of physics and engineering in a real-life flight experiment managed throughout by MSFC. This critical collaboration produced 86 Stanford doctorates and 14 from other universities (including 5 from UAH), over an extraordinary range of topics.

According to Einstein, a gyroscope in a 640 km polar orbit around the Earth is subject to two non-Newtonian precessions, a 6.6 arc-s/yr geodetic effect in the plane of the orbit and a 0.039 arc-s/yr frame-dragging effect due to the rotation of the Earth. Gravity Probe B measured both. To determine these tiny effects required a gyroscope 10^7 times better than the best Earth-based inertial navigation gyroscopes and a reference telescope 10^3 times better than any prior star tracker. My presentation describes the unique combination of cryogenics and space technologies that made this possible, and also some on-orbit surprises and how they were overcome.

Space makes new physics possible in 8 distinct ways. GP-B has been the largest of a series of NASA missions in Fundamental Physics. The flight experience will inform the development of several important future missions including LISA and STEP.

Biography

Francis Everitt obtained his PhD from Imperial College, London in paleomagnetism with proof that Britain in Carboniferous times was 10° south of the equator. Two years at the University of Pennsylvania then led to the discovery of 3rd sound in superfluid helium. At Stanford since October 1962, he has been engaged in space research, in particular the NASA Gravity Probe B and STEP missions. In 2005, he was awarded the NASA Distinguished Public Service Medal. His deep interest in the history of 19th and 20th century physics was recognized in the award of a Guggenheim Fellowship. He has written a biography of James Clerk Maxwell and most recently an article “Kelvin, Maxwell, Einstein, and the Ether: Who was Right about What?”